REMARKS

Claims 1, 3-4, 6, 8-10, 21 and 23-28 are presently pending in the application.

Applicants are pleased to note the Examiner's withdrawal of the previous rejections of the claims as being anticipated by or unpatentable over the patents of Wossner or Fauser. However, Applicants strenuously object to the Examiner's re-searching of the presently claimed invention to find additional prior art to reject the claims, even though the claims were essentially unchanged in scope after the last Office Action, the only amendments being formal in nature. This was not simply an updating of the search to possibly find newly available art, but a new search for old art which has always been available to the Examiner during the pendency of this application. Such a new search by the Examiner violates the Patent Office principle of compact prosecution and is therefore improper. Nevertheless, Applicants will respond to the new rejections as set forth below.

The Examiner has rejected claims 1, 6, 8-10, 21 and 25-28 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent 3,262,758 of James et al. Referring particularly to Figs. 1 and 2 and column 2, line 24 – column 3, line 60, the Examiner contends that James discloses a reaction segment having a catalyst bed 22 for oxidizing carbon monoxide; a reformed gas inlet 6 for introducing primary reformed gas stream 2; a reformed gas pathway (indicated by the solid-line flow arrows) for supplying reformed gas to the reaction segment 22; an oxidant gas supplying segment 7 for introducing oxygen-containing gas stream 3 into the reformed gas pathway; a cooler (steam boiler section between partitions 18 and 19) for cooling an upstream side of the catalyst bed 22; and means for heating a downstream side of the catalyst bed, wherein the heating means comprises a portion of the reformed gas pathway (presumably referring to the portion of the chamber 8 below or near the lower baffle 11 holding the catalyst bed 10) at least partially surrounding the catalyst bed 22, so as to inherently heat the downstream side of the catalyst bed 22 by the reformed gas and inherently cool the reformed gas in the reformed gas pathway by transfer of heat energy through wall 8 before passing through the cooler via central conduit 13 and fire tubes 17.

With respect to claims 26 and 25, the Examiner acknowledges that James does not explicitly illustrate a gas flow rate control valve, but argues that such control means would be inherent in the apparatus in order to provide "a stoichiometric proportion of air."

Regarding claims 8 and 26, the Examiner contends that James discloses a reformed gas pathway having a first direction prior to passing through the cooler and a second opposing direction passing through the catalyst bed 22.

Regarding claim 9, the Examiner contends that James discloses a reaction segment located outside the reformed gas pathway (CO-oxidation bed 22 being annular and having a central reformed gas pathway defined by inner container 8).

Regarding claim 10, the Examiner contends that James discloses a reaction segment which is tube shaped (annular CO-oxidation bed 22) and the reformed gas pathway before passing through the cooler being formed around the reaction segment 22 (a portion bypassed around the heat exchange section).

Regarding claims 27 and 28, the Examiner contends that James discloses that the reformed gas pathway (within inner chamber 8) heats the catalyst bed 22 by direct heat transfer through the wall.

The Examiner concludes that the claims structurally read on the apparatus of James. These rejections are respectfully but strenuously traversed for the reasons set forth in detail below.

First, the Examiner contends that the heating means "at least partially surrounds the catalyst bed 22." This is incorrect. Thus, The Random House Dictionary of the English Language, Second Edition unabridged (1983) defines "surround" as 1. to enclose on all sides, encompass . . .; 2. to form an enclosure round; encircle . . . . However, the reformed gas pathway of James (through chamber 8 and catalyst bed 10) does not "surround" in any way the catalyst bed 22. Instead, it is on the inside of catalyst bed 22, such that catalyst bed 22 surrounds the chamber 8 and catalyst bed 10.

Second, the Examiner contends that the reformed gas pathway of James (catalyst bed 10 and chamber 8) inherently heats the downstream (lower) side of bed 22, and the reformed gas is inherently cooled by the transfer of heat energy through wall 8 to the catalyst bed 22 before passing through the cooler. This is not necessarily correct, and in order to base a rejection on inherency, the Examiner must establish that the structure of the reference necessarily achieves the claimed result.

In fact, although the gas mixture entering the bottom of the inner container 8 is at 2,000°F and the temperature of the catalyst bed 10 is 1,650°F, this change in temperature is not necessarily because the reformed gas stream loses its heat to the catalyst bed 22, but because 1,650°F is a typical temperature of the catalyst bed 10 for a reforming reaction (see column 2, lines 67-68).

Thus, a reforming reaction on the catalyst bed 10 is an auto-thermal type reaction, where a water vapor reforming reaction and a hydrogen oxidizing reaction are mixed. Since the water vapor reforming reaction is an endothermic reaction, the heat required for this reaction is compensated by the oxidation reaction. It is therefore natural to conclude that the decrease in temperature from 2,000°F to 1,650°F is mainly attributed to absorption of heat through the reforming reaction, not to heat loss to the catalyst bed 22. In fact, James does not intend for the wall of chamber 8 to be a heat transfer wall. Instead, he attempts to avoid such heat transfer by lining the chamber 8 with a refractory lining 9 (see column 2, line 62).

Further, contrary to the Examiner's contention, it cannot be said that the temperature of the catalyst bed 22 necessarily increases from the upstream side to the downstream side, i.e., is heated at the downstream side. Thus, the catalyst bed 10 in chamber 8 has a complex temperature distribution because of its mixed state of a water vapor reforming reaction as an endothermic reaction and a hydrogen oxidizing reaction as an exothermic reaction. Hence, there are some cases where the temperature increases from the downstream side to the upstream side of the catalyst bed 10. In such a case, the catalyst bed 22 could be heated at the upstream end and cooled by heat lost from the catalyst bed 10. Therefore, the Examiner's contention of inherency is again incorrect, because the heating and cooling alleged by the Examiner do not necessarily occur in the James apparatus. Accordingly, reconsideration and withdrawal of the rejections based upon James are respectfully requested.

The Examiner has further rejected claims 1, 6, 8-10, 21 and 25-28 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent 5,609,832 of Mieville et al. ("Mieville"). Referring particularly to Fig. 1 and column 4, line 9 – column 5, line 2, the Examiner contends that Mieville discloses an apparatus comprising a reaction segment (converter 22) having a catalyst bed 24 for oxidizing carbon monoxide in exhaust gas hydrocarbons; a reformed gas inlet (tube 30) and a reformed gas pathway (solid-line flow arrows) for supplying reformed gas to the

reaction segment 22; an oxidant gas supplying segment for supplying oxidant gas to the reformed gas pathway (not shown in Fig. 1, but disclosed at column 11, lines 26-30 where supplemental oxygen is provided to ensure effective catalytic conversion); a cooler (outlet pipe 32 with fins 50 on the outer surfaces thereof) for cooling an upstream side of the catalyst bed 24; and means for heating a downstream side of the catalyst bed 24, wherein the heating means comprises the pathway portion within the converter jacket 28 at least partially surrounding the catalyst bed 24 and communicating with open ended heat exchange ducts 26 separated from the catalyst bed 24 by the walls defining the converter and ducts, so as to inherently heat the downstream side of the bed 24 by the reformed gas introduced from inlet 30 and inherently cool the reformed gas in the reformed gas pathway by direct heat transfer of heat to the catalyst bed 24 via the walls of converter 22 and the ducts 26.

Regarding claims 6 and 25, the Examiner concedes that a gas flow rate control valve is not illustrated in the figures or explicitly stated, but must be inherently present in the apparatus of Mieville to enable control of the air/fuel mixture, the amount of supplemental oxygen and the ability to make an adjustment providing extra combustion air.

Regarding claims 8 and 26, the Examiner contends that Mieville discloses the reformed gas pathway having a first direction prior to passing through cooler 50 (from left to right in jacket 28) and a second opposing direction through the catalyst bed 24 (from right to left in Fig. 1).

Regarding claim 9, the Examiner contends that Mieville discloses the reaction segment catalyst 24 being located outside the reformed gas pathway (i.e., outside the pathway defined by the portion traversing the open ended heat exchange ducts 26).

Regarding claim 10, the Examiner contends that Mieville discloses a tube shaped reaction segment (converter 22 packed with catalyst 24) and the reformed gas pathway before the cooler being formed around the reaction segment 24 (exhaust gas portion flowing through jacket 28 around segment 24).

The Examiner concludes that the claims structurally read on the apparatus of Mieville. This rejection is also respectfully but strenuously traversed for the reasons set forth in detail below.

To demonstrate the error of the Examiner's position, there is attached hereto a schematic diagram of the temperature profiles produced by the apparatus of the present invention and the apparatus of Mieville et al. The left hand diagram shows that the catalyst bed 11 of the present invention is cooled at the upstream side and heated at the downstream side, so that the temperature profile of the catalyst bed goes from cool to hot.

In contrast, the catalyst bed 24 of Mieville is quite different where heat exchange ducts 26 run transversely through the catalyst 24. The horizontal cylinder jacket 28 surrounding the converter 22 is actually divided into upper and lower sections by an internal baffle 31. As a result, the hot exhaust gas entering through exhaust gas inlet tube 30 is confined to the upper portion of the hollow cylinder before passing through the ducts 26, and the exhaust gas after passing through the ducts 26 exits into the portion of jacket 28 below the baffle 31, not from upstream end (right hand end) to downstream end (left hand end) of the converter 22 in Fig.1 of Mieville.

Further, while it could be argued that the exhaust gas generally travels longitudinally to the right in the jacket 28 of Fig. 1 of Mieville, and the cooled exhaust gas generally travels longitudinally from right to left through tube 40-46, the only heat exchange referred to in Mieville between the exhaust gas and the converter 22 is the heat exchange through exchange ducts 26 which run transversely through the converter 22 in contact with the catalyst 24. Mieville says nothing about any heat transfer from the exhaust gas across the outer walls of the converter 22. Therefore, it appears that the heat exchange occurs at the generally central portion of the converter 22, not at the right and left (upstream and downstream) ends of the converter 22. Hence, again, the Examiner's assumption that there is inherent heating of the downstream side of the bed 24 is erroneous.

In view of the above, the Examiner's anticipation rejection based upon Mieville on the ground of inherency is improper, and reconsideration and withdrawal of the rejections are respectfully requested.

Further, the Examiner has rejected claims 3, 4, 23 and 24 under 35 U.S.C. § 103(a) as being unpatentable over James in view of U.S. Patent 3,345,136 of Finneran et al. ("Finneran"). The Examiner contends that James further discloses passing the cooled gas stream through one or more beds of promoted iron oxide catalyst in order to react carbon monoxide with steam. The

Examiner acknowledges that James is silent as to whether the one or more beds may be configured of an upstream catalyst formed of a different catalyst material than the downstream side. However, the Examiner contends that Finneran teaches a first stage in which the catalyst is active at a relatively high temperature to convert the bulk of the carbon monoxide and a second stage where the catalyst is active at a relatively low temperature to produce hydrogen under conditions which favor a low residual proportion of carbon monoxide. The Examiner concludes that it would have been obvious to use the configuration of Finneran for the one or more beds of catalyst 22 in the James apparatus, because the selection of two catalyst stages of different activities indicated allows a substantial portion of the CO to be converted to CO_2, while producing low levels of residual CO and a high degree of conversion to hydrogen.

This rejection is also respectfully but strenuously traversed. Applicants do not contest that the conversion of residual carbon monoxide in two stages with catalysts active at different temperatures is generally known. However, the Examiner does not suggest how the teachings of Finneran would be incorporated in the apparatus of James. Even if the combination of references were proper, the combination would still not teach the presently claimed invention of claims 3, 4, 23 and 24, in view of the above deficiencies of James. Accordingly, reconsideration and withdrawal of this rejection are also respectfully requested.

Finally, the Examiner has rejected claims 3, 4, 23 and 24 under 35 USC § 103 as being unpatentable over Mieville. The Examiner contends that Mieville discloses a variety of catalyst material supports, including metallic materials, and further discloses an embodiment operated with NO_x-reducing catalysts, such as those containing rhodium, ruthenium or similar metals, in channels 124 ahead of absorber portion 126 and a platinum or standard 3-way catalyst in channels 124' after absorber portion 126. The Examiner acknowledges that Mieville is silent as to whether the downstream catalyst may exert inactivity at a lower temperature than the upstream catalyst. However, the Examiner concludes that it would have been obvious to one skilled in the art to select catalyst materials having appropriate activity-to-temperature profiles for the upstream and downstream portions in converter 22 of the Mieville apparatus.

This rejection is respectfully but strenuously traversed, because the Examiner has totally distorted the teachings of the Mieville reference and has misapplied them to the present claims. First, the Examiner has taken teachings from the embodiment of Fig. 7 and attempted to apply

them to the embodiment of Fig. 1 of Mieville, which are two totally different constructions, and the teachings of Fig. 7 are not transferable to the arrangement and teachings of Fig. 1 of Mieville.

Second, since Mieville is directed to a totally different art than the present invention, namely an emissions control system, not a reformed gas converter for a hydrogen purifying apparatus, the Examiner's contentions that it would have been obvious to select catalyst materials having appropriate activity-to-temperature profiles for the upstream and downstream portions of the converter 22 of Mieville on the basis of suitability for intended use and result effective variables are unwarranted when applied to the presently claimed invention. Thus, the present invention is not directed to an apparatus for purifying exhaust gas streams of motor vehicles, and the intended use and result effective variables of the two systems are quite different. The present invention is directed to a reformed gas conversion for hydrogen purifying apparatus, and one skilled in the art would therefore not look to and would not discover the optimum or workable ranges working with the emissions control system of Mieville.

In any event, the rejection is also improper for the same reasons as discussed above with respect to the Examiner's rejection of claims 1, 6, 8-10, 21 and 25-28 based upon anticipation by Mieville under 35 U.S.C. § 102(b). Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

In view of the above Remarks, it is submitted that all of the claims patentably distinguish over the newly cited prior art of record. Accordingly, reconsideration and an early Notice of Allowance are respectfully solicited.

Respectfully submitted,

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(Date)

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Temperature profile diagrams of present invention and Mieville